Service Manual

ControlMaster Plus Travel (CMPT)
Adjustable Frequency Drive
Service Manual

R&M
MATERIALS
HANDLING
INC.

R&M Materials Handling, Inc.
4501 Gateway Boulevard
Springfield, Ohio 45502
☎ : (937) 328-5100
FAX: (937) 325-5319

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Read the instructions supplied with the hoist before installation and commissioning.

Keep the instructions in a safe place for future reference.

Table of content

1 General 3
1.1 Technical data 3
1.2 Type mark coding 4
1.3 Basic description 4
1.4 Main components 5
1.5 Functional description 5
1.6 Control methods 6
1.6.1 Description of the control methods, EP 7
1.6.2 Description of the control methods, EP3 7
1.6.3 Description of the control methods, MS 8
1.7 Mechanical brake control 8
2 Start-up procedure 9
2.1 Visual checks 9
2.2 Checks before the first test run 9
2.3 Test run 10
2.4 After the test run 10
3 Service 11
4 Troubleshooting 12
4.1 Inverter fault codes 12
5 Drawings 16
5.1 Description of terminals 16
5.1.1 Terminal in 002-011F 16
5.1.2 Terminal in 015F 18
6 Parameter adjustments 19
6.1 The display panel 19
6.2 Programming principles 20
7 Parameter descriptions 21

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1 General

CAUTION

- Before starting, carefully read these instructions and this table.
- Verify that all connections are according to the electrical drawings.
- Verify that the motor supply is connected correctly. An improper connection will destroy the inverter.
- Verify that the internal voltage selections of the device are correct.
- Check that the device cover is properly installed and all ventilation holes are clear and uncovered.
- Check that the hot air coming from brake resistors does not cause any danger.
- High voltages are present in this device. Do not make any inspections until the power supply has been disconnected at the main switch. Before opening the device cover, wait at least 5 minutes after the display lamps turn off.
- An insulation resistance test, using a megger, requires special precautions.
- Do not make any measurements inside the device when it is connected to the main supply.
- Do not touch the IC-circuits on the circuit boards. Static voltage discharge may destroy the components.
- It is forbidden to use radiophones and portable phones near this device with the enclosure doors open.
- All the doors and covers must be closed during crane operation.

1.1 Technical data

Power class	002F	003F	004F	005F	007F	011F	015F
Power (kVA) at 400V	4.5	5.5	7	9	13	17	22
Output current In (A)	6.5	8	10	13	18	24	32
Max. current 1min (A)	10	12	15	20	27	36	48
Overload ability	1.5 x In , 1min/10min / 2.5 x In , 2s/20s (<50% speed)						
Max. output voltage	Equal to supply voltage						
Supply							
Supply voltage	F-series 380-500VAC						
Allowable voltage fluctuation	+/- 10%						
Nominal supply frequency	50/60Hz +/- 5%						
Signal input levels							
Digital controls	S1, S2, DIA3, DIA4, DIA5, DID1, DID2, DID3, DID4, DID5: 42 … 240VAC; 15mA						
Encoder feedback	EA+/- and EB+/-; 0/24V; 3kΩ; floating differential inputs						
Control features							
Control method	Open loop vector control						
Frequency control range	0 ... 120Hz						
Frequency command	Motor potentiometer or 2-4-step controller						
Limit switch functions	Slowdown and stop limit inputs for both directions						
Speed control range	s_N ... 100% (s_N= motor nominal slip)						
Speed accuracy	1% of nominal speed at speed range 10 ... 100% 1/3 of motor nominal slip at speed below 10%						
Extended speed range	100 ... 200%						
Braking torque	125%						
Protections							
Motor overload protection	Thermistor based temperature measurement						
Overload protection	Fault is detected if the current momentarily exceeds 280% of rated current						
Undervoltage / blown fuse	Fault is detected if DC voltage drops below 65% of rectified supply voltage						
Overvoltage protection	Fault is detected if DC voltage exceeds 911V						

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Momentary power loss	Immediate fault stop
Inverter overtemperature	Temperature sensor on the heat sink
Mechanical brake	Circuit breaker
Braking transistor	Electronic supervision
Ground fault	Provided by electronic circuitry
Ambient conditions	
Ambient temperature	-10°C ... +55°C (14°F ... 131°F) for ED≤60%
Storage temperature	-40°C ... +60°C (-31°F ... 140°F) dry
Humidity	<95%RH (no condensation)
Altitude	Maximum 1000m at In. Above 1000m: In reduces 1% per each 100m. Above 3000m: consult factory.
Vibration	Operation: maximum displacement amplitude 3mm at 2-9Hz. Maximum acceleration amplitude 0.5g (5m/s²) at 9-200Hz Confirms to LV and EMC directives.

1.2 Type mark coding

The Adjustable Frequency Drive can be summarized as a "crane traveling motor control system, which controls the speed by changing the frequency of supply voltage of a squirrel cage motor". A stepless speed adjustment can be achieved by this method.

Type marking is shown below.

D2T	007	F	V	50

D2T	Device name
007	Power rating class *002 – 015*
F	Supply voltage *F 380 - 500VAC, 50/60Hz*
V	Control voltage *Y 42VAC, 50/60Hz* *P 48VAC, 50/60Hz* *T 115VAC, 50/60Hz* *V 230VAC, 50/60Hz*
50	Revision code The latest revision may differ

1.3 Basic description

The Adjustable Frequency Drive has many advantages and offers many new features, when compared to other inverter-based systems, which might be used in crane applications.

Inverter	The inverter in the Adjustable Frequency Drive is a crane inverter. The specific crane features for the inverter hardware and the special software are achieved by combining the experience and know-how of crane applications with the latest technology. The inverter uses vector calculation for several different motor control modes.
Crane user interface	The Adjustable Frequency Drive has exactly the same interface with pre-designed locations for all typical crane functions. The main part of this interface is carried out by a terminal strip, which has separated sections for signals with main, control and electronics voltage levels.
Brake control	The Adjustable Frequency Drive includes the brake contactor and the full/half-wave rectifier for brakes.
Electrical Braking	The Adjustable Frequency Drive includes the braking transistor, which is dimensioned for every crane application. For resistor braking, the Adjustable Frequency Drive includes a braking resistor.
Control methods	The Adjustable Frequency Drive can be controlled by the electronic potentiometer control with 2-step pushbuttons and by the multistep control with 2-4-step controllers. Both these control methods are

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	available with every Adjustable Frequency Drive.
Limit switch functions	The Adjustable Frequency Drive has built-in slowdown and stop limit switch functions for both running directions.
Protections	The Adjustable Frequency Drive includes a motor thermal protection, which is based on motor temperature measurement by thermistors placed in motor windings. Other protections that may be included Adjustable Frequency Driveare shown in the technical data.

1.4 Main components

The main components are:

A1	Inverter	
F7	Circuit breaker	
K7	Brake contactor	
G1	Brake control unit REC12	002-011
G1	Brake control unit ESD141	015

The most important external components are:

R1	Braking resistor unit
M1	Traveling motor
Y1	Mechanical brake
B6	Thermal sensor for motor protection
	Control devices (switches, pushbuttons etc.)
	Limit switches

1.5 Functional description

Operation when power is switched on

- The contacts of the limit switches -S11, S12, S21 and S22 and the Emergency Stop button-ES are normally closed.
- The control voltage is supplied to terminal X1:37. The main voltage is connected to inverter power supply and the inverter powers up. If the control voltage is connected to RDY-signal and the fault circuit is OK, inverter is ready to operate in about 1-2 seconds.
- If either of the direction signals -S1 or S2 is on, the display shows F52 and driving can begin only after the direction signals have been off for a while.

Normal operation

- For the description of the speed reference setting see chapters "Control methods" and "Parameter Descriptions".
- Running starts when switch-S1 (S2) closes. Closing contact ROB2 on inverter-A1 energizes brake contactor-K7, which opens the brake. The Adjustable Frequency Drive accelerates according to the acceleration ramp setting to the selected speed.
- When switch-S1 (S2) opens, the Adjustable Frequency Drive stops according to the deceleration ramp setting and the brake closes.
- Braking resistor unit-R1 dissipates the regenerated energy during deceleration. The power supply to R1 is controlled by A1. If the braking resistor fan(s) are included in the Adjustable Frequency Drive, the cooling device will operate when power is supplied to the braking resistors. The cooling continues for about 4-5 minutes after the occurrence of electrical braking. This is to ensure that the temperature of the resistors stays below 150°C (302°F).

Other features

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- By opening the slowdown limit switches-S11 and S21, the maximum speed can be limited. The slowdown speed is adjustable by parameter.
- If contact RDY opens for any reason, operation of the inverter is stopped.
- The thermistor relay function is used when needed.
- When the stop limit switch, S12 or S22 opens, K7 de-energizes and the mechanical brake stops the motion.
- The extended speed range ESR can be used, if the signal FWE (field weakening enabled) is turned on.

1.6 Control methods

There are three different control methods (command modes) available:

1	EP2	Electronic motor potentiometer function. Stepless control using a 2-step pushbutton controller.
2	EP3	Electronic motor potentiometer function. Stepless control using a 3-step controller.
3	MS	Multistep control (4 steps)

The control mode is selected by parameter P2.1.4. The parameters assign digital inputs S1, S2, OK, DIA3-DIA5 and DID1-DID5. It is not possible to change the functions of the inputs individually. The input assignment according to the selected mode is explained in the following table.

Control mode		**EP**	**EP3**	**MS**
Parameter P2.1.4		**1**	**2**	**3**
Signal	Terminal			
S1	X1:8	S1	S1	S1
S2	X1:9	S2	S2	S2
OK	X1:7	OK	OK	OK
DIA3	X1:10	AP	AP	MS2
DIA4	X1:11	Not used	HOLD	MS3
DIA5	X1:12	Not used	not used	MS4
DID1	X1:38	FWE	FWE	FWE
DID2	X1:39	S11	S11	S11
DID3	X1:40	S21	S21	S21
DID4	X1:41	S12	S12	S12
DID5	X1:42	S22	S22	S22

Desired speed levels for multi-step control mode are selected with following parameters

Speed	**Parameter**	**Input**
Speed 1	P2.2.8. / P2.2.9.	S1/ S2
Speed 2	P2.1.7.	MS 2
Speed 3	P2.1.8.	MS 3
Speed 4	P2.1.9.	MS 4

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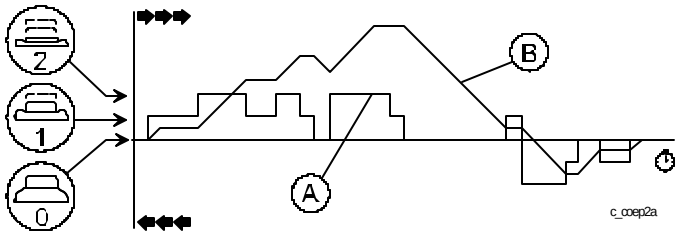
1.6.1 Description of the control methods, EP2

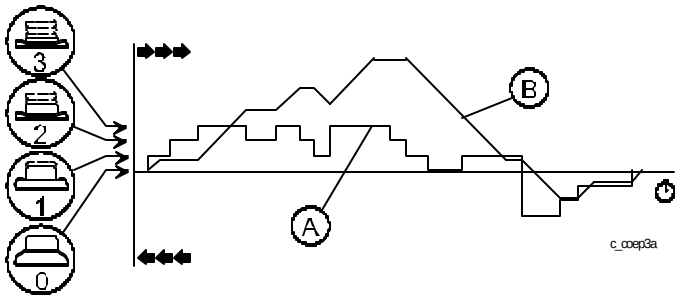


0. Decelerate
1. Maintain speed
2. Accelerate
A. Pushbutton position
B. Speed

EP2-control uses a 2-step pushbutton. The operation is as follows:

- Rest position means standstill (0-position)
- During run, rest position means deceleration
- Step one (switch S1 or S2) means hold speed
- When starting, step one means acceleration up to the minimum speed
- Step two (switch AP) means acceleration (up to the maximum speed if desired)
- At the maximum speed step two means hold speed, because the maximum speed cannot be exceeded

1.6.2 Description of the control methods, EP3



0. Decelerate
1. Minimum speed
2. Maintain speed
3. Accelerate
A. Pushbutton position
B. Speed

EP3-control uses a 3-step controller. The operation is as follows:

- Rest position means standstill (0-position)
- Step one (switch S1 or S2) is the minimum speed command
- Step two (EP hold command) means hold speed
- Step three (switch AP) means acceleration (up to the maximum speed if desired)
- When releasing the controller, step one means deceleration down to the minimum speed

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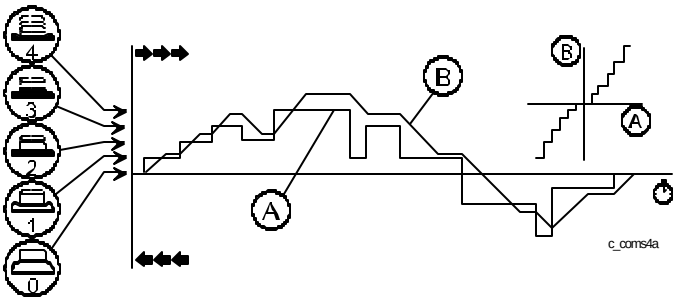
1.6.3 Description of the control methods, MS



A. Pushbutton position
B. Speed

MS-control uses a 2-step pushbutton, or 3, 4-step controller. The operation is as follows:
- Each step has its own frequency
- Frequencies are freely selectable
- When the pushbutton/controller is set to a certain step, the speed changes to equal value

1.7 Mechanical brake control

The Adjustable Frequency Drive includes a brake contactor to control the electromechanical brake. The brake operates on DC-voltage. When power is removed to the brake, a spring force closes the brake.

The brake is controlled to remain closed until the motor first generates enough starting torque and then the brake is opened. The same applies for stopping;, the motor still generates torque while the brake is being closed. During a direction change, the brake is kept open all the time. After the run command is switched off, the Adjustable Frequency Drive decelerates the motor to a stop according to the preset deceleration time. The brake is used as a holding brake, and this way, wear on the brake is minimized. However, if a failure occurs or the Emergency Stop button is pushed, the brake closes immediately, stopping the motor and the load.

Models 002F-005F use a REC12 brake control unit, which is a line voltage, half-wave rectifier. The half-wave rectifier reduces losses and is enough to open the brake. A contactor switches the line voltage on and off.

Models 007F-015F use an ESD141 brake control unit, which is a line voltage, full/half-wave rectifier. Full-wave rectification is used to open the brake quickly. Then, the rectifier changes over to half-wave, which reduces losses, but is enough to hold the brake open. A contactor switches the line voltage on and off. The same contactor also disconnects the DC-voltage directly from the brake coil, which assures that the brake closes fast.

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2 Start-up procedure

If any problems or malfunctions occur during the start-up, refer to the Chapter “Troubleshooting”, to find out the reason. All problems must be solved before continuing. For more information, contact crane-service personnel.

Warning! High voltages inside the device. Wait for at least five minutes after the supply voltage has been switched off before servicing. Display in operating condition (lights on) indicates a dangerous voltage on the DC-bus. When the display turns off, the DC-bus voltage is about 100V. Note also that there is a dangerous voltage in the braking resistor when the DC-bus is charged.

Do not connect any voltage to the output terminals (U, V, W). Otherwise, the inverter will be damaged.

The overload protection protects both the supply and the motor cables. The fuses of the supply provide short circuit protection.

2.1 Visual checks

- Check the condition of cubicles.
- Check that the Adjustable Frequency Drive serial number is the same as in delivery documents.
- Check the cabling/wiring to the motor, brake, and thermistors.
- Check the motor type.
- Check the wire terminations in the motor connection box
- Check the wire connections for motor, thermistors and brake wear.
- Disconnect motor leads (U, V, W) and brake wires to prevent damage to the inverter. Measure isolation resistance of brake coil and motor windings (each phase to ground).
- Re-connect motor leads and brake wires.
- Check the braking resistor.
- Terminals, X1:21-27 and X1:51-57 are for electronics level signals.
- Normally only shielded wires are connected to these terminals. Check that no control or line-voltage level wires are connected there.

2.2 Checks before the first test run

Warning! High voltages inside Adjustable Frequency Drive.

- Check the power supply voltage (nominal voltage +/- 10%).
- Check the control voltage (nominal voltage +/- 10%).
- Make sure that the run commands are off (pushbuttons / controller (master switch) at zero position).
- Turn on the power from the main switch and the control voltage switch.
- Within about 1 second, the control panel should display "AC on", and then in about 1 second the display changes to motor output frequency "0.00" and the green READY status indicator turns on.
- In a fault situation the red FAULT status indicator blinks and the display shows a fault code instead of frequency.
- Check that the green RUN status indicator is off.
- Check that the external connections and the selected input set, P 2.1.4. are according to application.
- Parameters are properly set after the factory tests and adjustments are not needed except for the parameters that depend on the crane application. Write down to the parameter list all the values that have been changed and at the end save parameters to display file 2.

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2.3 Test run

- Make sure that the movement will not cause any danger to the environment or to the crane itself. Avoid driving close to the limit areas.
- Check limit switches manually if possible.
- Check the run commands on display panel matches the traveling direction. The arrow rotates clockwise if S1 (right/forward) is applied and counter-clockwise if S2 (left/backward) is applied.
- Drive forward at minimum speed for 5 to 10 seconds. Accelerate to full speed. Run 5 to 10 seconds. Stop. Repeat the same in the reverse direction. Check the frequency display to make sure that the frequency changes through the whole operational frequency range from minimum to nominal speed.
- Check the motor operation (acceleration, deceleration and braking): accelerate to full speed forward, change to full speed backward and full speed forward again and stop.
- Check the limit switch functions: drive slowly to limit switches and check the slowdown and stop limit switch operations. Re-check using full speed. Repeat the same check for the other direction.
- If the optional ESR is used, check the maximum frequency as stated in the testing table.

2.4 After the test run

- Record all parameter value changes in the parameter list.
- Make sure all remarks and setting values are recorded.
- It is recommended to store the parameter settings in the memory of the display panel, file 2.

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3 Service

The Adjustable Frequency Drive does not require regular maintenance. The following actions are recommended:

- Check inverter fault history
  Find out the reasons of any possible faults
  Clear the fault history
- Clean the heat sink on the inverter
  Prevent the dust to spread inside cubicles
  Lock the fans before blowing compressed air
- Check that there are no abnormal noises coming from the cooling fans
- Tighten all screws and connectors
- Clean the dust from PC-boards

☞ The parameters are saved in an EEPROM, which keeps the parameters in memory after power off without any battery backup.

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4 Troubleshooting

Warning! High voltages inside the frequency converter. Wait for at least five minutes after the supply voltage has been switched off before servicing. Display in operating condition (lights on) indicates a dangerous voltage on the DC-bus. When the display turns off, the DC-bus voltage is about 100V. Note that there is a dangerously high voltage in the braking resistor when the DC-bus is charged.

This chapter describes how to troubleshoot inverter faults. The purpose is to find out which components are damaged and how to replace or restore them for proper operation. Advice is also given to find the possible external failures that could affect the Adjustable Frequency Drive function.

4.1 Inverter fault codes

If any one of the following faults occurs, the inverter displays the fault code and the operation of the crane/hoist is stopped. If several faults occur one after another, the latest one is displayed, while the others are stored to the fault history page on the inverter. The Adjustable Frequency Drive includes an automatic fault reset operation; the fault code stays on the display until the fault is removed and the controller is released back to 0-position. Some of the fault codes require to switch the power off before run is possible.

When the fault supervision trips, the FAULT indicator turns on and the blinking fault code “F xx“ (xx = fault number) appears on the display. The faults are stored to the fault history; from there they can be seen if necessary.

Fault code	Fault	Possible cause	Checking
F 1	**Overcurrent**	Inverter has measured too high current (over 4*In) in the motor output: sudden heavy load increase short circuit in the motor or cable not suitable motor wrong motor parameters	Reset: switch power off and restart after the lamps of display are off. Check: motor type and power rating parameters motor cables motor insulation brake operation motor loading
F 2	**Overvoltage**	DC-bus voltage has exceeded 135% maximum level, 911Vdc (F-series), 1258 Vdc (K-series) supply voltage raised >1.35 x Un (high overvoltage spikes at mains) deceleration time is too short	Check: adjust the deceleration time longer measure main supply voltage level and wave form while not driving motor insulation motor cable insulation (phase-ground, phase-phase) braking resistor cable braking resistor type and resistance braking chopper operation

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F 3	**Earth fault**	Current measurement has sensed unbalance in motor phase currents. Supervision level is 5% of inverter nominal current not symmetric load insulation failure in the motor or the cables	Reset: switch power off and restart after the lamps of display are off. Check: motor insulation motor cable insulation (phase-ground, phase-phase)
F 4	**Unknown**		
F 5	**Charging switch**	Charging switch is open when START command becomes active interference fault component failure	Reset: switch power off and restart after the lamps of display are off. Check: control unit and power unit connections charging resistors If the fault comes again, change the control unit.
F 6	**Emergency Stop**	Either the ES or RDY-signal has been tripped during	Check: ES and RDY external connections brake operation
F 7	**Saturation trip**	Very high overload or defective component	Reset: switch power off and restart after the lamps of display are off. Check: motor and motor cable insulation measure main circuit diodes and IGBT transistors If the fault comes again, change the power unit.
F 8	**Unknown**		
F 9	**Undervoltage**	DC-bus voltage has dropped below 65% of rectified supply voltage main supply voltage <0.65 x Un inverter fault can also cause an undervoltage trip external fault during run may cause an undervoltage trip	In case of temporary supply voltage break, reset the fault and start again. Check mains input. If mains supply is correct, an internal failure has occurred. Contact crane service.
F 10	**Input line supervision**	One input line phase is missing or supply voltage parameter is wrong	Check: supply voltage main connection.
F 11	**Output phase supervision**	Current supervision has sensed that one of the motor phases has no current	Check: motor cable connections measure motor phase currents and compare to display value
F 12	**Braking chopper supervision**	During run braking chopper have short test pulse every 1s period. Test pulse measures transistor collector voltage. Fault appears if braking resistor is broken braking chopper is broken braking resistor is not installed	Reset: switch power off and restart after the lamps of display are off. Check: braking resistor and cable resistance and insulation resistance measure braking transistor IGBT and free wheeling diodes If resistor is OK, then the

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			chopper is broken Contact service
F 13	**Inverter undertemperature**	Temperature of heat sink is below acceptable operating level (-10°C /14°F)	Check ambient temperature cubicle heating
F 14	**Inverter overtemperature**	Temperature of heat sink is over acceptable operating level +80°C (176°F). Overtemperature warning is issued when the heat sink temperature exceeds +75°C (167°F)	Check: ambient temperature fan operation cooling air flow through heat sink heat sink is not dusty
F 22 **F 23**	**EEPROM checksum fault**	Parameter restoring error interference fault component failure (control unit) faulty supply voltage programming	After power is off, the inverter will automatically load factory-default parameter settings. Drive does not work properly nor enable driving after this fault. Check: all parameter settings. If the fault comes again, contact service.
F 24	**Changed data warning**	Changes may have occurred in the different counter data due to mains interruption	No special actions required. Take a critical attitude to the counter data.
F 25	**Microprocessor watchdog-fault**	interference fault component failure (control unit)	Reset: switch power off and restart after the lamps of display are off. If the fault comes again, contact service.
F 26	**Power Unit Fault**		
F 32	**Fan cooling fault**	Cooling fan of the frequency converter do not work, when ON command has been given	If the fault comes again, contact service.
F 33	**Memory fault**		
F 34	**Communication fault**		
F 35	**Application fault**	Run-time exception in the application program	
F 36	**Control Unit**	Faulty Control Unit.	Contact service.
F 37	**Device changed**	Option board changed. Different power rating of drive	Reset the fault
F 38	**Device added**	Option board added. Drive of different power rating added	Reset the fault
F 39	**Device removed**	Option board removed. Drive removed	Reset the fault
F 40	**Device unknown**	Unknown option board or drive.	Check board and drive type.
F 41	**IGBT temperature**	Too high temperature in IGBT transistors. long duration overload lowered cooling high environment temperature	Check: motor loading brake operation inverter heatsink inverter cooling fan operation environment temperature
F 48	**EEprom CRC-fault**		
F 50	**Reference value fault**	Analog input signal is out of selected range 1-9V or 2-10V control cable is broken signal source has failed	Check reference cable reference source
F 51	**Stop limit**	Stop limit has tripped	Reset: keep controller at zero >500ms. Ensure that fault disappears after leaving the stop limit.
F 52	**Panel communication**	Poor connection between inverter and display panel	Check the panel connection and optional cable.

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	error		
F 53	**Profibus communication error**	Not used in Adjustable Frequency Drive	Contact crane service.
F 54	**Profibus control fault**	Not used in Adjustable Frequency Drive	Contact crane service.
F 55	**Board Fault**	Some of following board is missing: A=Basic I/O board B=Thermistor board D=Expansion board	Check board slots A, B and D
F 56	**Generator side current limit**	Too short deceleration time generator side current limit	Check: deceleration time encoder pulses current limit setting
F 57	**Thermistor fault**	Expansion board thermistor input has detected motor overtemperature	Check: motor cooling and loading thermistor connection. If expansion board thermistor input is not used, it should be jumpered parameters the brake operation
F 60	**Parameter fault**	Inverter has lost parameters	Contact service
F 61	**Overspeed Fault**	Not used in Adjustable Frequency Drive	Contact crane service.
F 62	**Speed Difference Fault**	Not used in Adjustable Frequency Drive	Contact crane service.
F 63	**Stall Supervision Fault**	Not used in Adjustable Frequency Drive	Contact crane service.
F 64	**SSU Relay Test Fault**	Not used in Adjustable Frequency Drive	Contact crane service.
F 65	**SSU Watchdog**	Not used in Adjustable Frequency Drive	Contact crane service.
F 66	**SSU Overspeed Limit**	Not used in Adjustable Frequency Drive	Contact crane service.
F 67	**Encoder channel B**	Not used in Adjustable Frequency Drive	Contact crane service.
F 70	**Multicare Fault**	Not used in Adjustable Frequency Drive	Check: other drive fault history brake relay control delay settings
F 71	**Brake Control Fault**	Not used in Adjustable Frequency Drive	Check Ain2 wiring Check hoist control unit settings
F 72	**Brake Feedback Fault**	Brake is opening or closing in wrong time	Check: brake operation Check brake relay (ROB2) and brake contactor (K7/K71) operation

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5 Drawings

5.1 Description of terminals

5.1.1 Terminal in 002-011F

No	Name	Description, signal level
	PE	
L1	L1	Power supply, phase 1
L2	L2	Power supply, phase 2
L3	L3	Power supply, phase 3
U	U	Motor output, phase 1
V	V	Motor output, phase 2
W	W	Motor output, phase 3
B+	R+	Braking resistor
R-	R-	Braking resistor

No	Name	Description, signal level	No	Name	Description, signal level
1	BL1	AC brake supply, phase 1	31	BD1	DC brake supply 1
2	BL2	AC brake supply, phase 2	32	BD2	DC brake supply 2
3	BL3	AC brake supply, phase 3	33	T1	Thermistor input
4	T12	Reserved for thermistors connections	34	T2	Thermistor input
5	OLE	External control voltage, 48/115/230Vac	35	ONE	Neutral of external control voltage OLE
6	OLE	External control voltage, 48/115/230Vac	36	ONE	Neutral of external control voltage OLE
7	RDY	Stop with brake	37	ES	External Stop
8	S1	Direction 1 run command	38	DID1	Free input
9	S2	Direction 2 run command	39	DID2 (S11)	Slowdown signal, direction 1
10	DIA3	Multi Function Input	40	DID3 (S21)	Slowdown signal, direction 2
11	DIA4	Free input	41	DID4 (S12)	Stop limit signal, direction 1
12	DIA5	Free input	42	DID5 (S22)	Stop limit signal, direction 2
13			43		
14			44		
15	K7-A1	Coil of brake contactor K7	45	ROB1-21	Free NC contact of ROB1
16	ROB1-22	Free C contact of ROB1	46	ROB1-23	Free NO contact of ROB1
17	ROD1-28	Free NO-contact of relay ROD1	47	ROD1-29	Free NO-contact of relay ROD1
18	K7-153	Free NO-contact of K7	48	K7-154	Free NO-contact of K7
19	K7-163	Free NO-contact of K7	49	K7-164	Free NO-contact of K1
20	K71-13	Free NO-contact of K71	50	K71-14	Free NO-contact of K71
	PE				

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21			51		
22			52		
23			53		
24			54		
25			55		
26			56		
27			57		

	PE	

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5.1.2 Terminal in 015F

No	Name	Description, signal level
	PE	
91	L11	Auxiliary power supply, phase 1
92	L12	Auxiliary power supply, phase 2
93	L13	Auxiliary power supply, phase 3

No	Name	Description, signal level	No	Name	Description, signal level
1	BL1	AC brake supply, phase 1	31	BD1	DC brake supply 1
2	BL2	AC brake supply, phase 2	32	BD2	DC brake supply 2
3	BL3	AC brake supply, phase 3	33	T1	Thermistor input
4	T12	Reserved for thermistors connections	34	T2	Thermistor input
5	OLE	External control voltage, 48/115/230Vac	35	ONE	Neutral of external control voltage OLE
6	OLE	External control voltage, 48/115/230Vac	36	ONE	Neutral of external control voltage OLE
7	RDY	Stop with brake	37	ES	External Stop
8	S1	Direction 1 run command	38	DID1	Free input
9	S2	Direction 2 run command	39	DID2 (S11)	Slowdown signal, direction 1
10	DIA3	Multi Function Input	40	DID3 (S21)	Slowdown signal, direction 2
11	DIA4	Free input	41	DID4 (S12)	Stop limit signal, direction 1
12	DIA5	Free input	42	DID5 (S22)	Stop limit signal, direction 2
13			43		
14			44		
15	K7-A1	Coil of brake contactor K7	45	ROB1-21	Free NC contact of ROB1
16	ROB1-22	Free C contact of ROB1	46	ROB1-23	Free NO contact of ROB1
17	ROD1-28	Free NO-contact of relay ROD1	47	ROD1-29	Free NO-contact of relay ROD1
18	K7-153	Free NO-contact of K7	48	K7-154	Free NO-contact of K7
19	K7-163	Free NO-contact of K7	49	K7-164	Free NO-contact of K1
20	K71-13	Free NO-contact of K71	50	K71-14	Free NO-contact of K71
	PE				
21			51		
22			52		
23			53		
24			54		
25			55		
26			56		
27			57		
	PE				

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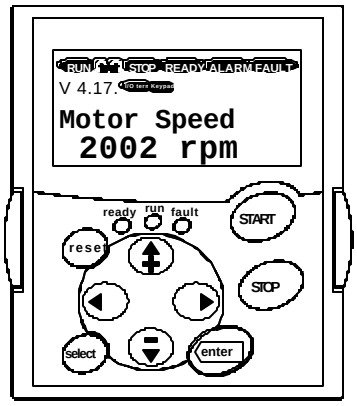
6 Parameter adjustments

6.1 The display panel



The display panel is used for:
- Displaying the drive identification, electrical values, operating or fault parameters
- Altering the parameter settings
- Saving and restoring the parameter settings in the memory of the display panel

Meaning of the displays:

RUN	Motor is running, blinks when ramping down.
	Indicates the direction of motor rotation.
STOP	Indicates that motor is not running.
READY	Lights up when power is on. In case of a trip, the symbol will not light up.
ALARM	Indicates that the drive is running outside of certain limit.
FAULT	Drive was stopped due to unsafe operating conditions
I/O term	I/O-terminals are the selected control place
Keypad	Keypad is the selected control place

The signaling LED's

"ready"	Lights up when power is on. In case of a trip, the symbol will not light up.
"run"	Motor is running, blinks when ramping down.
"fault"	Indicates that unsafe operating conditions were encountered due to which

Button description

reset	Reset active faults
select	Switch between two latest displays
enter	Confirmation of selections Fault history reset

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	Browse the main menu and the pages of submenus Edit values
	Move in menu Move cursor Exit and enter edit mode
	Start button Starts motor if the keypad is the active control place

6.2 Programming principles

To program the Adjustable Frequency Drive, change the parameter settings from the display panel. Moving from menu to menu is done from the browser buttons of the display panel and entering into a menu is done from the button.
The parameter values can be edited by entering the Parameter Menu from the Main menu when the location indication M2 is visible on the first line of the display.
Push the button once to move into the Parameter Group Menu. Locate the parameter group desired by using the and buttons. Push button again to enter the group and its parameters. Use again the and buttons to find the parameter you want to edit. Pushing the button takes you to the edit mode. As a sign of this, the parameter value starts to blink. You can now change the value in two different manners:

1. Set the new desired value with and buttons and confirm the change with button.Consequently, the blinking stops and the new value is at display.
2. Bush the button once again. Now you will be able to edit the value digit by digit. Confirm the change with .

The value will not change unless the button is pushed. Pressing the button takes you back to the previous menu.

WARNING! Changing parameter settings during running can cause a hazardous situation. Parameter settings must not be changed during running.

WARNING! Driving via display can cause a hazardous situation. Panel control must not be used.

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7 Parameter descriptions

Label	Code	Function/Description	Adjustment range
G2.1 General Parameters			
Password	P2.1.1	Password	0-65535
Supply Voltage	V2.1.2	Power unit nominal voltage	
Device	V2.1.3	Device	Industrial
Input Set	P2.1.4	Input Set selection, see chapter “Control methods”	1-3
Analog Input Sel	P2.1.5	Analog input selection, see chapter “Mechanical brake control”	0-3
Slow speed freq	P2.1.6	Speed when one of slow down limit switches (S11/S21) is open	Min. freq-Max.freq
Multistep 2 freq	P2.1.7	2nd preset speed. Multistep speed setting.	Min. freq-Max.freq
Multistep 3 freq	P2.1.8	3rd preset speed. Multistep speed setting.	Min. freq-Max.freq
Multistep 4 freq	P2.1.9	4th preset speed. Multistep speed setting.	Min. freq-Max.freq
Accel Time 1	P2.1.10	Acceleration ramp is defined from zero to motor nominal frequency P 2.2.2. Minimum setting is 1s	1-300
Decel Time 1	P2.1.11	Deceleration ramp is defined from motor nominal frequency P2.2.2 to zero. Minimum setting is 1s	1-300

G2.1.12 Multicare			
Test Voltage Min	B2.1.12.1	Not used in Adjustable Frequency Drive	
Test Voltage Max	B2.1.12.2	Not used in Adjustable Frequency Drive	
Ain 1 Value	P2.1.12.3.	Not used in Adjustable Frequency Drive	
Min Value Volt	P2.1.12.4.	Not used in Adjustable Frequency Drive	
Max Value Volt	P2.1.12.5.	Not used in Adjustable Frequency Drive	

G2.2 Motor Parameters			
Motor Nom Volt	P2.2.1	Nominal motor voltage Un from motor rating plate	0 – 750V
Motor Nom freq	P2.2.2	Nominal motor frequency fn from motor rating plate	0 – 250 Hz
Motor Nom Speed	P2.2.3	Nominal motor speed nn from motor rating plate	0 – 6000 rpm
Motor Nom Curr	P2.2.4	Nominal motor current In from motor rating plate	0 – 3000 A
Nom Flux Curr	P2.2.5	Nominal motor magnetizing current Io from motor rating plate	0 – 3000 A
Start Current	P2.2.6	Current at start, setting must not be changed	0 – 2000 A
Current Limit	P2.2.7	Inverter’s max. output current, must not be changed	0 – 3000 A
Min Freq S1	P2.2.8	Minimum frequency forward	0 – Max Freq
Min Freq S2	P2.2.9	Minimum frequency backward	0 – Max Freq
Max Freq S1	P2.2.10	Maximum frequency forward	0 – Max Freq
Max Freq S2	P2.2.11	Maximum frequency backward	0 – Max Freq
Max ESR freq	P2.2.12	Maximum frequency when ESR activated	Max Freq–250 Hz
Drive Selection	P2.2.13	Application selection, setting must not be changed	0 - none 1 - travel 2 – hoisting
Pulse Wheel ppr	P2.2.14	Pulse wheel pulse number, not used in Adjustable Frequency Drive	
Zero Freq Volt	P2.2.15	Output voltage at zero frequency	0 - 250 Hz
U/f Mid Volt	P2.2.16	Voltage in the selected middle point	0 – 3000 V
U/f Mid Freq	P2.2.17	Middle point frequency	0 – 250 Hz
Torque Boost	P2.2.18	Torque maximisation, setting must not be changed	0=OFF, 1=ON
RS Voltage Stop	P2.2.19	Relative value of motor stator impedance voltage drop	0 –512
Stop Function	P2.2.20	Stopping mode selection 0: When the drive command is switched off the motion is stopped according to the set deceleration ramp.	0 - 1

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		1: When the drive command is switched off the motor current is cut off and the mechanical brake stops the motion.	

G4. Monitoring			
G4.4. Fault Counter			
Fault Counter	R4.4.1.	Fault counter value. Fault number	
Total Faults	V4.4.2	Total number of all faults	

G4.6. Digital Input			
S1	V4.6.1.	State of digital input S1	0=OFF, 1=ON
S2	V4.6.2.	State of digital input S2	0=OFF, 1=ON
DIA3	V4.6.3.	State of digital input DIA3	0=OFF, 1=ON
DIA4	V4.6.4.	State of digital input DIA4	0=OFF, 1=ON
DIA5	V4.6.5.	State of digital input DIA5	0=OFF, 1=ON
OK	V4.6.6.	State of digital input OK	0=OFF, 1=ON
DID1	V4.6.7.	State of digital input DID1	0=OFF, 1=ON
DID2	V4.6.8.	State of digital input DID2	0=OFF, 1=ON
DID3	V4.6.9.	State of digital input DID3	0=OFF, 1=ON
DID4	V4.6.10.	State of digital input DID4	0=OFF, 1=ON
DID5	V4.6.11.	State of digital input DID5	0=OFF, 1=ON
Basic Board	V4.6.12.	State of board A inputs, S1,S2,DIA3,DIA4,DIA5	0=OFF, 1=ON
Extension Board	V4.6.13.	State of board D inputs, DID1 – DID5	0=OFF, 1=ON

G4.7. SSU			
Overspd Lim 1	V4.7.1.	Value of overspeed limit 1. Not used in D2L.	%
Overspd Lim 2	V4.7.2.	Value of overspeed limit 2. Not used in D2L.	%

Freq Ref	V4.8.	Frequency reference	Hz
SpeedReg	V4.9.		Hz
Distance Counter	V4.10.	Calculates the distance from slow down limit. Operates within slowdown area. Not operating if parameter P5.2. value is 0	m
DC-Link Voltage	V4.11.	Measured DC-link voltage	V
Heat Sink Temp	V4.12.	Measured heat sink temperature	°C
Motor Power	V4.13.	Calculated motor power	%
Motor Voltage	V4.14.	Calculated motor voltage	%
Motor Torque	V4.15.	Calculated actual torque	%
Motor Current	V4.16.	Measured motor current	%
Motor Speed	V4.17.	Calculated motor speed	rpm
Output Frequency	V4.18.	Output frequency to the motor	Hz

G5 Panel Control			
Panel Control	B5.1.	Must not be used.	0=OFF, 1=ON
Speed Reference	R5.2.	Speed reference for panel control	

M6 System Menu			
Application	S6.1.	Application	
Language	S6.2	Keypad language	

S6.3. System settings			
Password	S6.3.1	Must not be used	

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Parameter lock	P6.3.2	Prohibit changes to parameters	Change Enable / Change Disable
InternBrake Res	P6.3.3.	Setting must not be changed	Connected / Not Connected
Fan Control	P6.3.4.	Fan control	0=continous / 1=temperature
Multmon. page	P6.3.5.		0=Change Enable /1=Change Disable
HMI ACK timeout	P6.3.6	HMI ACK timeout	
HMI retry	P6.3.7.	HMI retry	

S6.4. Keypad settings			
Default page	P6.4.1.	Default page to which the display automatically moves as the Timeout time has expired or as the power is switched on to the keypad. If the Default Page value is 0 the function is not activated, i.e. the last displayed page remains on the keypad display.	
Default page/OM	P6.4.2.		
Timeout time	P6.4.3.	The time after which the keypad display returns to default page.	
Contrast	P6.4.4.	Display contrast.	
Backlight time	P6.4.5.	Determines how long the backlight stays before going out.	

S6.5. Param Transfer			
Up to keypad	S6.5.1	The parameter transfer function is used when the operator wants to transfer one or all parameter groups from one drive to another. All the parameter groups are first uploaded to the keypad, then the keypad is connected to another drive and then the parameter groups are downloaded to it (or possibly back to the same drive).	
Downfrom keypad	S6.5.2	see. S6.5.1	
Parameter Sets	S6.5.3.	Transfer parameters from / to parameter set	Store Set 1 Load Set 1 Store Set 2 Load Set 2
Param BackUp	P6.5.4	If value is “yes”, parameter backup will be done at every power up without user confirmation	Yes / No

S6.6. Param Comparison			
Set 1	S6.6.1.	Actual parameter values are compared to Set 1 parameter values.	
Set 2	S6.6.2.	Actual parameter values are compared to Set 2 parameter values.	
Factory settings	S6.6.3.	Actual parameter values are compared to inverter manufacturer defaults, do not use	
Keypad set	S6.6.4.	Actual parameter values are compared to parameter values loaded to keypad.	

S6.7. Info			
Power unit	I6.7.1.	Manufacturer data	
Unit voltage	I6.7.2.	Nominal voltage of the power unit	
Software version	I6.7.3.	Control unit software version.	
Firmware interf.	I6.7.4.	Application interface version of the software.	

S6.7.5. Expanders			
A:	E6.7.5.1.	Type of expander board at slot A	NXOPTA6
State	E6.7.5.1.1.	State of expander board at slot A	RUN
Program version	E6.7.5.1.2	Software version of expander board at slot A	

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B:	E6.7.5.2.	Type of expander board at slot B	NXOPTA3
State	E6.7.5.2.1.	State of expander board at slot B	RUN
Program version	E6.7.5.2.2	Software version of expander board at slot B	
C:	E6.7.5.3.	Type of expander board at slot C	No board
State	E6.7.5.3.1.	State of expander board at slot C	RUN
Program version	E6.7.5.3.2	Software version of expander board at slot C	
D:	E6.7.5.4.	Type of expander board at slot D	NXOPTB9
State	E6.7.5.4.1.	State of expander board at slot D	RUN
Program version	E6.7.5.4.2	Software version of expander board at slot D	
E:	E6.7.5.5.	Type of expander board at slot E	No board
State	E6.7.5.5.1.	State of expander board at slot E	RUN
Program version	E6.7.5.5.2	Software version of expander board at slot E	

S6.7.6. Applications			
A6.7.6.1. Adjustable Frequency Drive			
Application id	D6.7.6.1.1	Application identification number	
Version	D6.7.6.1.2	Application version number	
Firmware interf	D6.7.6.1.3	Firmware interface number	

S6.7.7. Debug
Not used in Adjustable Frequency Drive

S6.8. Counters			
MWh counter	C6.8.1.	MWh counter, cannot be reset	
Op Day Counter	C6.8.2.	Operation day counter, cannot be reset	
Op. hour counter	C6.8.3.	Operation hour counter, cannot be reset	

S6.9. Trip counters			
MWh Counter	T6.9.1.	MWh counter, can be reset	
Clr MWh Counter	P6.9.2.	Clear MWh counter	
Op Day Counter	T6.9.3.	Operation day counter, can be reset	
Op hour Counter	T6.9.4.	Operation hour counter, can be reset	
Clr Optime cntr	P6.9.5.	Clear Operation time counters	

M7 Active faults			
		The memory of active faults can store the maximum of 10 faults in the order of appearance. By pushing the ⊙ button you will enter the Fault-time data record menu indicated by T.1-T.13. In this menu some selected important, data valid at the time of the fault, are recorded.	
	T.1	Counted operation days	d
	T.2	Counted operation hours	hh:mm:ss
	T.3	Output frequency	Hz
	T.4	Motor current	A
	T.5	Motor voltage	V
	T.6	Motor power	%
	T.7	Motor torque	%
	T.8	DC voltage	V
	T.9	Unit temperature	°C
	T.10	Ready	0=Not Ready 1=Ready

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		Run	0=Not Running 1=Run
	T.11	Direction Fault	0=Off 1=On 0=No 1=Yes
	T.12	Warning At reference	0=No 1=Yes 0=No 1=Yes
	T.13	0-speed	0=Not Zero Speed 1=Zero Speed

M8 Fault history			
		The fault memory can store a maximum of 30 faults in the order of appearance. The number of faults currently in the fault history is shown on the value line of the main page. The order of the faults is indicated by the location indication in the upper left c orner of the display. The latest fault carries the indication F8.1, the second latest F8.2 etc. The Fault-time data record pages are accessible at each fault. If there are 30 uncleared faults in the memory, the next occurring fault will erase the oldest from the memory. Pressing the Enter button for about 2 to 3 seconds resets the whole fault history.	

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